7: International Bank N, S-4 (1951) 1952 MH1 Iraq MH1

yields. As will be indicated later, inorganic fertilizers could probably be produced cheaply in Iraq and organic fertilizers could be produced as by-products of the slaughtering industry.

4. Livestock Improvement

The productivity of livestock is extremely low, primarily because of inadequate feed supply. In addition to the production of fodder crops, measures should be taken to improve natural pasture lands, particularly in the northern mountains, which have generally suffered from over-grazing. Reseeding and rotational grazing are necessary. Productivity could be further raised by the establishment of shelters, better breeding methods, especially the introduction of new and improved sires and maintenance of stud stations, and by more effective control of parasitic diseases through an increase in the number of veterinarians and the provision of more extensive diagnostic facilities in the provinces.

The quality of livestock products could be raised considerably by a number of measures. One of these is an improvement in the practices and more stringent sanitary supervision of abattoirs. Others would be the establishment of a number of wool shearing and grading units under the guidance of an appropriate expert; appointment of a hides and skins expert to serve as general manager of the newly established Hides and Skins Association; and recruitment of an abattoir specialist to train local abattoir supervisors in improved methods of flaying and preserving hides and skins.

At present, even the major cities are without a clean, safe milk supply. The supply of milk could be substantially improved by better feeding of livestock, concentration of milking cattle in well-equipped settlements on the outskirts of cities, and central collection, transportation and processing of milk under strict sanitary controls. The possibility of cooperative collection and processing of milk should be explored.

Since the nomads and semi-nomads, who may number from 200,000 to 500,000, account for a large proportion of the livestock in the country, particularly sheep and goats, their needs must receive special attention. Measures should be taken, for instance, to provide them with better watering facilities, sheep-dipping stations,

7: International Bank N, S-4 (1951) 1952 MH1 Iraq MH1

In addition to the above-mentioned enterprises, it may well be desirable to establish a paper mill as soon as there is an assured supply of pulp from abroad. As the demand for paper bagging for domestically produced fertilizers and cement increases, it will probably be more economical to produce such paper in Iraq than to import it. A plant for the manufacture of glass bottles, other containers and tumblers might also be started, provided the availability of the right type of sand can be confirmed.

The largest and perhaps the most promising industrial possibility lies in the utilization of the natural gas produced in conjunction with oil and now almost totally wasted. The Mission recommends therefore that early consideration be given to the erection, near Kirkuk, of a plant which, using natural gas and gypsum as raw materials, would be capable of producing annually 500,000 tons of ammonium sulphate fertilizer, 100,000 tons of elemental sulphur, 10,000 tons of carbon black and 300,000 tons of cement. Since the natural gas contains about 10.5 percent of hydrogen sulphide by volume, it would be worthwhile to establish a plant to recover sulphur from all of the gas produced. Part of the cleaned gas would then be cracked thermally, producing hydrogen after removal of the carbon black. In the most important part of the plant the hydrogen and nitrogen won by removing carbon monoxide and carbon dioxide from the flue gases would be synthesized under high pressure into ammonia. Ammonia and carbon dioxide would then be passed through a slurry of finely ground gypsum, yielding calcium carbonate and ammonium sulphate. The latter would be sold as fertilizer and the former used to make cement. Such a plant could produce fertilizer very cheaply, thereby stimulating its use in Iraq; and any fertilizer not consumed domestically would find a ready market abroad. Sulphur and carbon black could be used in the production of rubber tires in Iraq and would also be in great demand abroad; and there will undoubtedly be a growing demand for cement in Iraq. The plant would cost aproximately ID 25,000,000, of which the sulphur recovery plant would account for about ID 8,750,000 and the cement plant for ID 1,500,000. It should be attempted only if a reliable foreign chemical concern can be interested in designing and erecting it and undertaking its operation under a management contract.

7: International Bank N, S-4 (1951) 1952 MH1 Iraq MH1

241

possible more intensive utilization of the land. Experiments conducted over a long period in the United States have shown the reaction of wheat yields to fallow, fertilizer and crop rotation. The results indicate that yields respond most favorably to fertilizers used in combination with a crop rotation scheme.[6] There is great need to do more experimental work in Iraq in order to determine the optimum rates of fertilizer applications for various crops, the best time of application and the effect of green manure on production.

The high cost of fertilizers may have deterred their use. This [387] handicap may be overcome if steps are taken to carry out the Mission's proposals to establish a large nitrogen plant at Kirkuk as well as a number of small bonemeal plants.

Tools and Draft Power

In discussing the need for weed control, reference has already been made to the lack of adequate equipment and good draft animals. In some parts of Iraq hand cultivation without the use of draft power may still be seen. In other parts, however, one can see the most modern tractors and combines at work in the fields.

Better tools and draft power will no doubt help to improve the productivity of the land both by destroying weeds and by better preparation of the soil. Similarly, better threshing equipment will raise the quality of the grain. This does not mean, however, that mechanization of agriculture will necessarily be the appropriate solution. Most farmers do not have sufficient land or money to warrant the purchase of a tractor or combine, and cooperative ownership will inevitably develop rather slowly. Moreover, under existing conditions the cost of amortization, operation and maintenance may be too high in relation to the cost of labor. Better plows drawn by sturdy animals may have largely the same effect as tractor-drawn plows in destroying weeds and improving prep-

[6] Yields under various conditions were as follows in terms of bushels per acre:

1. Continuous wheat, without fertilizer	12.33
2. Continuous wheat, with fertilizer	23.58
3. Wheat after one year of fallow	22.00
4. Wheat in a 4-year rotation, without fertilizer	24.00
5. Wheat in a 4-year rotation, with fertilizer	32.00

7: International Bank N, S-4 (1951) 1952 MH1 Iraq MH1

working shops, battery and electrical repair work, shops for repair of automotive and agricultural equipment, bakeries, confectioneries and food processing establishments of various kinds. The amount of capital required in individual cases is quite small but, in the aggregate, it adds up to a considerable sum. The Industrial Bank should arrange for a small-enterprise section to make surveys of small industries in each community, advise them concerning ways of improving their methods of production and assist in getting proper financial help where it is justified. It is estimated that ID 400,000 would be sufficient to meet the needs of these industries over the next five years.

The assistance of small industries by the Industrial Bank is to be preferred to assistance or stimulation of so-called cottage industries. Cottage industries may be of benefit in the over-populated areas of Asia, but for Iraq they do not appear to be an appropriate solution to industrial growth. Iraq's population is small in relation to the resources available. Over the long term its problem is not primarily one of creating a maximum number of jobs with a minimum of capital but rather one of utilizing capital resources in ways which will make a permanent addition to the productive capacity of the country and to the building of modern industrial enterprises.

Establishment of New Industries

The entrance of industry into new fields would help to balance the over-all development of the country and to utilize its resources more fully. At the same time it would increase employment and thereby aid in raising the general standard of living.

Nitrate Fertilizer, Sulphur and Cement Plant

The largest and perhaps most promising possibility for new industrial development lies in the utilization of the natural gas produced in conjunction with oil. Upon completion of the 30-inch pipeline, oil production at the Kirkuk field will be at a rate which will make more than 25 billion cu. ft. of gas available per year. For the most part, this gas will be wasted until some means is found for its economic utilization. This gas contains, according

7. International Bank N. S-4 (1951) 1952 MH1 Iraq MH1

382 387 to information afforded the Mission, 10.5 percent by volume of hydrogen sulphide with the remaining products being different types of hydrocarbons, chiefly methane. In the same area there are also large deposits of gypsum or hydrous calcium sulphate.

These waste gases and gypsum could be utilized for the economic manufacture of ammonium sulphate, a valuable fertilizer for agriculture; and, in the process, sulphur, carbon black and cement would become available as by-products. A plant of economic size and capable of satisfying approximately one half of Iraq's eventual needs should have an annual capacity of approximately 500,000 tons. In addition to ammonium sulphate, this plant would also produce approximately 100,000 tons of elemental sulphur and 300,000 tons of cement.

The most important part of such a plant would, of course, be that making ammonia. By this process, nitrogen and hydrogen under high pressure are synthesized into ammonia by means of a catalyst. Hydrogen for this process would be obtained by thermally cracking the gas and subsequently removing the carbon black, while nitrogen would be obtained by removing carbon dioxide and carbon monoxide from the flue gases.

The ammonia thus produced would then be combined with the sulphate radical from the gypsum. This is generally done by passing ammonia and carbon dioxide through a slurry of finely ground gypsum and mechanically separating the resultant products of ammonium sulphate and calcium carbonate. The ammonium sulphate which is in solution would be crystallized in evaporators while the calcium carbonate would be used in making cement.

Since the gas used in making ammonia must be free of sulphur, the plant would need to contain facilities for its removal. This could be accomplished in several ways, but a detailed study would probably show a combination of the Girbotal and Claus processes to be best suited for this particular project.

Facilities for the production of the required power and process steam would be conventional in every respect and would use gas for fuel.

In the first few years of operation, all of the products except cement would probably be exported. Later, however, only sulphur

7: International Bank N, S-4 (1951) 1952 MH1 Iraq MH1

and carbon black might be exported, with the ammonium sulphate being utilized domestically as fertilizer.

The integrated plant is estimated to cost approximately ID 25,000,000, including foreign exchange estimated at ID 22,000,000 mainly in pounds sterling. The total estimated cost of the plant may be broken down as follows:

Ammonium Sulphate and Carbon Black	ID 14,750,000
Sulphur Recovery	8,750,000
Cement Plant	1,500,000
Total Cost	ID 25,000,000

Estimates indicate that the plant may show net earnings of 18.5 percent on the investment and may break even when approximately 40 percent of its capacity is utilized. In these estimates the gross income has been figured on the basis of c.i.f. prices currently prevailing in London and the plant has been amortized over 15 years with interest payable at 4½ percent per annum. The underlying calculation is summarized below:

GROSS ANNUAL INCOME			
Ammonium sulphate	500,000 tons @ ID 15 per ton	ID 7,500,000	
Sulphur	100,000 tons @ ID 16 per ton	1,600,000	
Carbon black	10,000 tons @ ID 93 per ton	930,000	
Cement	300,000 tons @ ID 5 per ton	1,500,000	
Total			ID 11,530,000
ANNUAL OPERATION COSTS			
Amortization and interest		2,310,000	
Freight (Rail and Ocean)		2,379,000	
Bags		650,000	
Maintenance		375,000	
Salaries		530,000	
Labor		146,000	
Material and Supplies		55,000	
Gas		135,000	
Contingency		300,000	
Total			ID 6,880,000
Estimated Net Profit			ID 4,650,000

The plant would probably need to be financed in its entirety by the Development Board, and it should be attempted only if a

7: International Bank N, S-4 (1951) 1952 MH1 Iraq MH1

382 387 reliable foreign chemical firm can be secured to design and construct it and, at least at the outset, operate it under a management contract.

The plant would give permanent employment to about 1,000 workers.

387 237 ***Bone Meal Plants***

Another promising field for new industry is the conversion of the waste products from abattoirs to fertilizers for domestic use. Bone meal, for example, is a very valuable fertilizer. Yet at present Iraq, with no domestic plant to utilize them, is exporting approximately 15,000 tons of bones per year to Europe.

There would probably be sufficient demand for fertilizer to support three plants, located at Basra, Baghdad, and Mosul. Their combined cost would probably amount to roughly ID 50,000, of which ID 45,000 would be in foreign exchange, principally pounds sterling. With help from the Industrial Bank, this could probably be financed by the abattoir owners. When completed the plants would give employment to about 60 workers.

Steel

327 Iraq is now producing about 5,000 tons of steel scrap per year. It is recommended that a small hand-operated mill and electric melting furnace be set up to convert this scrap into reinforcing bars, window shapes and small angles, all of which are in great demand. This mill ought to be located in Baghdad and arrangements made to obtain off-peak power from the Baghdad power plant or from the railroad shops. As an alternative to electric melting, crucibles might be considered. In either case, the cost of the plant would be approximately ID 300,000, including ID 200,000 in foreign exchange, mostly in hard currency. This mill could not satisfy the whole of Iraq's steel needs; nevertheless, it would furnish about 5,000 tons per year of certain types at probably half the cost of the imported steel it would replace.

The mill could be financed by private capital with help from the Industrial Bank. Foreign technicians would be required dur-